

Advanced Filtering Techniques Applied to Spaceflight, Phase II

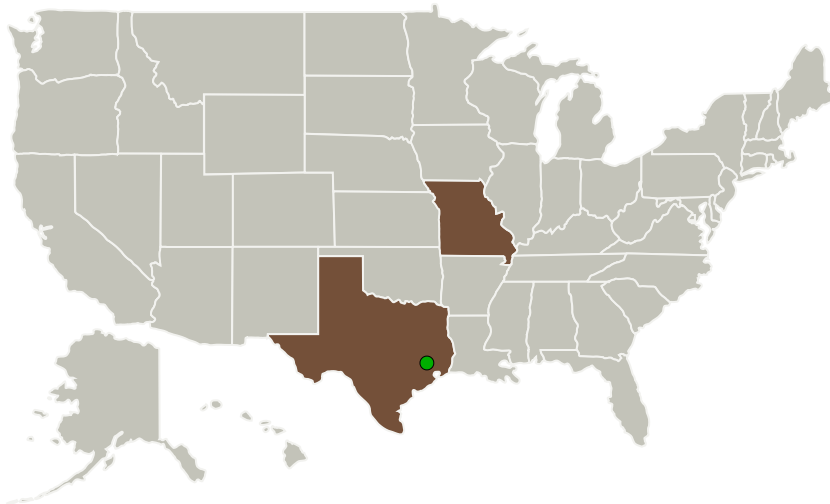
Completed Technology Project (2011 - 2013)



Project Introduction

IST-Rolla developed two nonlinear filters for spacecraft orbit determination during the Phase I contract. The theta-D filter and the cost based filter, CBF, were developed and used in various orbit determination scenarios. The scenarios were application to low Earth orbit, range only, and range and range rate estimation. The modified state observer was also developed to estimate uncertainty in the dynamic model besides estimation of orbital states. Phase I research showed that there is a problem with the linear-like form that is used by many nonlinear filters such as the State Dependant Riccati Equation filter (SDRE filter), and the theta-D and CBF. A study of the observability led to important discoveries about the lack of observability in some formulations. Detailed study of the working of the proposed nonlinear filters in terms of observability and their application to more precise orbit determination and model uncertainty estimation will be undertaken in Phase II. Also learned from Phase I, IST-Rolla will focus more on how and where these nonlinear filters can help NASA. There will be three main applications studied during Phase II: interplanetary orbit determination, space debris tracking, and interplanetary landing spacecraft tracking. These applications were chosen because of their relevance to current NASA missions and the nonlinearity of the measurements involved should show the need for the nonlinear filters. Furthermore, working algorithms and software will be given to NASA to test on ongoing applications.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
IST-Rolla	Lead Organization	Industry Minority-Owned Business	Rolla, Missouri
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

Missouri	Texas
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Project Transitions

**June 2011:** Project Start**December 2013:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/138669>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

IST-Rolla

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Jason Searcy

Co-Investigator:

Jason Searcy

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Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.2 Navigation Technologies
 - └ TX17.2.5 Rendezvous, Proximity Operations, and Capture Sensor Processing and Processors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System